Supplementary Files

Online Resource 1

Definition (based on ICNARC report on COVID-19 in critical care)(1)

Comorbidities must have been evident within the six months prior to critical care and documented at or prior to critical care:

- Cardiovascular: symptoms at rest
- Respiratory: shortness of breath with light activity or home ventilation
- Renal: renal replacement therapy for end-stage renal disease
- Liver: biopsy-proven cirrhosis, portal hypertension or hepatic encephalopathy
- Metastatic disease: distant metastases
- Haematological malignancy: acute or chronic leukaemia, multiple myeloma or lymphoma
- Immunocompromise: chemotherapy, radiotherapy or daily high dose steroid treatment in previous six months, HIV/AIDS or congenital immune deficiency
- Type II diabetes mellitus

Mechanical ventilation during the first 24 hours was identified by the recording of a ventilated respiratory rate, indicating that all or some of the breaths or a portion of the breaths (pressure support) were delivered by a mechanical device. This usually indicates invasive ventilation; BPAP (bi-level positive airway pressure) would meet this definition but CPAP (continuous positive airway pressure) does not.

Advanced respiratory support was defined as invasive ventilation, BPAP via trans-laryngeal tube or tracheostomy, CPAP via trans-laryngeal tube, extracorporeal respiratory support.

(1) Intensive Care National Audit & Research Centre. ICNARC report on COVID-19 in critical care 22 May 2020.

Online Resource 2

Study site	Viral testing panel
Nottingham University Hospitals	Influenza A & B, RSV, Rhinovirus, Enterovirus, Adenovirus, Parechovirus, Parainfluenza pool (types 1-4), Human metapneumovirus, Bocavirus
Newcastle Upon Tyne Hospitals	Influenza A & B, Respiratory syncytial virus (RSV), Rhinovirus, Human metapneumovirus, Adenovirus, Parainfluenza pool (types 1-4)
Brighton and Sussex University Hospitals	Influenza A & B, RSV
Guy's & St Thomas'	Influenza A & B, RSV, Enterovirus, Rhinovirus, Parainfluenza, Adenovirus, Human metapneumovirus
Salford Royal	Influenza A & B, RSV
University Hospitals of Derby & Burton	Influenza A & B, RSV, Parainfluenza, Rhinovirus, Human metapneumovirus, Adenovirus
University College London	Influenza A & B, RSV, Parainfluenza pool (types 1-4), Human metapneumovirus, Adenovirus, Rhinovirus

Online Resource 3

Study site	Met inclusion criteria[a]	Still in ICU[b]	Transfers from other hospital/ Hospital-acquired COVID-19[c]	Eligible[d]	Entered into database (% of those eligible)
Nottingham University Hospitals	97	11	1	85	79 (92.9)
Newcastle Upon Tyne Hospitals	100	4	20	76	48 (63.2)
Brighton and Sussex University Hospitals	58	8	4	46	45 (64.3)
Guy's & St Thomas' NHS Foundation Trust	316	0	103	213	34 (16.0)
Salford Royal	46	3	11	32	22 (68.8)
University Hospitals of Derby & Burton	54	1	0	53	16 (30.2)
University College Hospitals London	138	32	32	74	10 (13.5)
Total	809	59	171	579	254 (43.9)

d= a- (b+c)

Online Resource 4

Table S 1: Results and classification as likely pathogen or contaminant among positive cultures taken from patients

Blood culture

Likely pathogen	n	N	Likely contaminant	n	N
Coagulase negative Staphylococcus	13	6	Coagulase negative Staphylococcus	47	36
Enterococcus spp.	8	5	*Propionibacterium sp.*	2	2
Klebsiella spp.	3	2	*Streptococcus oralis*	1	1
Citrobacter koseri	3	2	*Micrococcus luteus*	1	1
Candida parapsilosis	1	1	*Diphteroid bacilli*	1	1
Escherichia coli	1	1	*Anaerobic streptococci*	1	1
Pseudomonas spp.	1	1	*Streptococcus species (Facklamia Languida)*	1	1
Staphylococcus aureus	1	1	*Streptococcus parasanguinis*	1	1
Haemophilus influenzae	1	1	*Granulicatella adiacens*	1	1
	32	20	*Saccharomyces cerevisiae*	1	1
			Actinomyces sp.	1	1
			Corynebacterium striatum	1	1
			Lysinbacillus sphaericus	1	1
				60	49

Legend:

n= Number of times an organism was cultured from a test sample

N= Number of patients from whom the organism was cultured in that test sample

BAL culture

Likely pathogen	n	N
Klebsiella spp.	17	14
Escherichia coli	7	5
Pseudomonas spp.	5	4
Enterobacter spp.	4	3
MRSA	4	2
Serratia marcesens	3	2
Staphylococcus aureus	3	3
Pluralibacter gergoviae	2	1
Proteus mirabilis	2	2
Citrobacter koseri	2	2
Raoultella sp.	1	1
Morganella morganii	1	1
Stenotrophomonas maltophilia	1	1
Haemophilus influenzae	1	1
	53	42

Likely contaminant	n	N
Candida spp	21	15
Enterococcus spp	2	2
Yeast	2	2
Upper respiratory tract flora	1	1
Streptococcus anginosus	1	1
	27	21

Legend:

n= Number of times an organism was cultured from a test sample

N= Number of patients from whom the organism was cultured in that test sample

Tracheal culture

Likely pathogen	n	N
Serratia marcesens	10	5
Enterobacter spp.	7	3
Escherichia coli	6	2
Klebsiella spp.	4	3
Raoultella sp.	4	1
Pseudomonas spp.	3	2
Proteus mirabilis	2	2
Staphylococcus aureus	2	2
Haemophilus influenzae	2	1
Aspergillus fumigatus	2	1
Citrobacter koseri	1	1
Acinetobacter baumanii	1	1
	44	24

Likely contaminant	n	N
Candida spp	10	6
Yeast	6	4
Mixed growth of Coliform & Candida	4	2
Respiratory commensals	2	1
Corynebacterium sp	1	1
	23	14

Legend:

n= Number of times an organism was cultured from a test sample

N= Number of patients from whom the organism was cultured in that test sample

Sputum culture

Likely pathogen	n	N
Pseudomonas spp.	19	11
Stenotrophomonas maltophilia	7	3
Escherichia coli	6	5
Klebsiella spp.	8	6
Citrobacter koseri	6	5
Enterobacter spp.	6	6
Staphylococcus aureus	7	6
Proteus mirabilis	2	2
Serratia marcesens	2	2
Burkholderia multivorans	2	1
Haemophilus influenzae	2	1
Pluralibacter gergoviae	1	1
Delftia acidovorans	1	1
Yersinia enterocolitica	1	1
Acinetobacter baumanii	1	1
	71	52

Likely contaminant	n	N
Candida spp	13	10
Enterococcus sp	2	2
Respiratory commensals	41	32
	56	44

Legend:

n= Number of times an organism was cultured from a test sample

N= Number of patients from whom the organism was cultured in that test sample

Online Resource 5

	Co-infection rate within 48 hours (1000 person-days) (95% CI)
Overall	28.2 (16.7-47.7)
Excluding Nottingham University Hospitals	32.0 (17.7-57.8)

Online Resource 6

Type of tests	On admission		After admission (within 48 hours)		Overall	
	n	N	n	N	n	N
Blood culture	223	174	89	46	312	220
BAL PCR/ culture, sputum culture, tracheal culture	18	15	34	31	52	46
Urinary pneumococcal antigen	25	25	55	51	80	76
Urinary legionella antigen	36	34	55	54	91	88
Respiratory viral PCR	119	106	32	22	151	128

Legend:

n= Number of tests done

N= Number of patients who had the test

Online Resource 7

	AMR	No AMR	Unknown	Total	Resistance n (%)
Klebsiella spp.	10	4	2	16	Co-amoxiclav, 2 (20); Cefuroxime, 7 (70); Piperacillin/Taz, 5 (50); Meropenem, 1 (10); Co-trimoxazole, 1 (10); Trimethoprim, 1 (10); Chloramphenicol, 1 (10)
Escherichia coli	11	9	0	20	Amoxicillin, 8 (72.7); Co-amoxiclav, 5 (45.5); Meropenem, 1 (9.1); Ertapenem, 1 (9.1)
Enterobacter aerogenes	3	2	0	5	Cefuroxime, 2 (40); Cefadroxil, 1 (20); Ceftazidime, 1 (20); Meropenem, 1 (20); Gentamicin, 1 (20)
Pseudomonas spp.	7	4	2	13	Ciprofloxacin, 2 (28.6); Ceftazidime, 2 (28.6); Piperacillin/Taz, 5 (71.4); Meropenem, 3 (42.9); Gentamicin, 1 (14.3); Amikacin, 1(14.3); Ticarcillin/ clavulanate, 1 (14.3)
Serratia marcescens	1	0	0	1	Piperacillin/Taz, 1 (100)
Citrobacter koseri	1	3	1	5	Piperacillin/Taz, 1(100); Meropenem, 1 (100)
Staphylococcus aureus	4	7	0	11	Flucloxacillin, 1 (25); Doxycycline, 2 (50); Clarithromycin, 3 (75); Clindamycin, 1(25)
Haemophilus influenzae	3	0	1	4	Amoxicillin, 3 (100); Co-amoxiclav, 3 (100); Cefuroxime, 2 (66.7); Doxycycline, 1 (33.3)
Acinetobacter baumanii	1	1	0	2	Ceftazidime, 1 (100)
Burkholderia multivorans	1	0	0	1	Meropenem, 1 (100); Ceftolozane/Tazobactam, 1 (100)
Enterococcus spp.	1	3	4	8	Amoxicillin, 1 (100); Gentamicin, 1 (100)
Morganella morganii	1	0	0	1	Cefuroxime, 1 (100); Piperacillin/Taz, 1 (100)
Raoultella sp.	1	0	0	1	Piperacillin/Taz, 1 (100)
Total	45	33	10	88	

Legend

- AMR is defined as resistance reported to one or more antimicrobial agents tested (excluding intrinsic resistances).(2) Information in this table is based on the antimicrobial patterns released by individual sites for clinicians, other resistance may have been present but not reported
- Piperacillin/Taz= Piperacillin/Tazobactam
- Co-pathogens (with AMR) breakdown by species
    - *Klebsiella spp.: Klebsiella pneumoniae (2), Klebsiella aerogenes (7), Klebsiella voriicola (1)*
    - *Pseudomonas spp.: Pseudomonas sp (1), Pseudomonas aeruginosa (6)*
    - *Enterococcus spp.: Enterococcus faecium (1)*

(2) The European committee and Antimicrobial susceptibility testing. Intrinsic Resistance and Unusual Phenotypes version 3.2 February 2020.